Ukrainian Journal of Ecology

Ukrainian Journal of Ecology, 2023, 13(4), 1-7, doi: 10.15421/2023_438

ORIGINAL ARTICLE

Assessment of weed species diversity on maize and wheat crops in Siltie and Gurage zones, Central Ethiopia

K. Bamud*, M. Kebede, B. Temam

South Agricultural Research Institute, Werabe Agricultural Research Center, P.O. Box 21 Werabe, Ethiopia

**Corresponding author E-mail: kedirbamud@gmail.com*

Received: *01 April, 2023; Manuscript No: UJE-23-94885;* ***Editor assigned:*** *03 April, 2023, PreQC No: P-94885;* ***Reviewed:*** *15 April, 2023, QC No: Q-94885;* ***Revised:*** *20 April, 2023, Manuscript No: R-94885;* ***Published:*** *28 April, 2023*

Maize and wheat are important stable food and cash crops in Ethiopia. However, the productivity and quality of these crops are highly limited by high weed infestations. Identification and quantification of weeds are very important. The survey was conducted to identify and document weed species in study areas. Therefore, the objectives were to determine the distribution of weeds, to document major cereal crops weed species and to identify newly introduced weeds in study areas. The study was carried out in Siltie zone (Sankura and Lanfuro districts) and Gurage zone (Mareko and Meskan districts) during 2022 cropping season. A total of 22 fields for each crop were randomly assessed within minimum of 3 kilometres distance. The selected field was assessed by using 0.5 m × 0.5 m quadrants. The assessment in farms was performed with a simple random sampling technique by throwing quadrants. There were three random sampling sites per field taken. The survey result revealed that thirteen weed families and twenty nine weed species were identified in maize field while fifteen weed families and thirty weed species in wheat field. The family Poaceae, Asteraceae and Solanaceae were dominant families in both maize and wheat fields. The frequency (0.05 up to 0.95%) and the dominance (0.09% up to 38.55%) of weed species were recorded in maize field, while the frequency (0.05 up to 0.95%) and the dominance (0.05% up to 57.81) of weed species in wheat field. Galinsoga parviflora, Phalaris minor and Guzotia scabra weeds in maize field and Galinsoga parviflora, Avena fatua, Guzotia scabra, Phalaris minor and Cyperus species weeds in wheat field were the most frequent and dominant weeds in four selected districts.

Keywords: Maize, Wheat, Assessment, Weeds, Field.

Introduction

Weeds are considered as one of the major case of maize and wheat fields and causing yield reduction and decrease their productivity. Weeds compete with crop for different aspects like water, nutrients and light and cause major extra output to the growers. They enable loss of maize and wheat yield crops and competition for plant nutrient (Dalley, et al., 2006; Abouziena, et al., 2007 and Rana, et al., 2016). Weed species vary greatly in their ability to compete with crops and reduce yields and may directly reduce profits by hindering harvest operations, lowering crop quality, and producing chemicals which are harmful to crop plants (Allelopathy). Uncontrolled weeds may harbor insects and diseases and produce seed or rootstocks which infest the field and affect future crops. Weed infestations serve as alternate host for insects and diseases, slow down harvesting operations,increase the cost production, reduce the market value of crops and increase the risk of fire in perennial crops, plantation and forest reserves (Tena, et al., 2012).

Weeds have the ability to withstand adverse and various conditions in the field, because they can modify their seed production and growth according to the environment or weather condition (Rao, et al., 2000). The initial weed emergence time differs from place to place and varies according to the species ecological requirements (mainly temperature and soil moisture content) (Rao, et al., 2000 and Rana, 2016). Weeds play an important role in the proper crop stand establishment, which ultimately affect productivity and

quality of the crops (Riar, et al., 2016). Weed community is changing depending on edaphic and climatic conditions (Walter et al., 2002). Most weeds are introduced or exotic weeds which introduced from other countries through major factors (Rana et al., 2016). Maize (*Zea mays* L.) is one of the most important cereal crops in the world. It ranks third position among other cereals after wheat and rice (FAOSTAT, 2013). It is the major and staple food and one of the main sources of calorie in the major maize producing regions (Tolessa, et al., 2001). In 2014/15 cropping season, about 2.1 million hectares of land was covered with maize with an estimated production of about 7.23 million tons (CSA, 2015). It ranks second after teff (*Eragrotis tef*) in area coverage, first in total national production and yield per hectare (CSA, 2015). Maize yield is far below expectation due to numerous factors which include weed infestation, low soil fertility and availability of labour. Weeds being a strong competitor with maize compete for light, space, water and other essential nutrients and results in yield loss (Ali, et al., 2003). They use the soil fertility, available moisture and nutrients, compete for space and light with crop plants, which result in yield reduction (Khan, et al., 2004).

Wheat is one of the major cereal crops produced in most highlands of the northern, central and south-eastern parts of Ethiopia with a record harvest of 4.6 million metric tons registered in 2017 (CSA, 2017). Currently, wheat is produced under rain fed conditions and irrigation. It is a staple food for over 90 million populations in the Ethiopian (FAO, 2015). Wheat plays a significant role in the national economy and currently its area of production and productivity is increasing. Moreover, it is one of the major cereals of choice in Ethiopia, dominating food habits and dietary practices. Yield reducing factors in wheat are soil fertility decline, weeds, disease, and insects.

Uncontrolled weed growth throughout the crop growth period caused a yield reduction of 72% of wheat (Tesfaye, et al., 2014). Such ineffective weed management is considered as the main factor for low yield of wheat resulting in yield loss of up to 58.6% when there is uninterrupted weed growth (Dawit, et al., 2014). The main purpose of assessing weed species is to know the weed species composition, which might have violent competition with the crop and essential for a comprehensive understanding of the weed problem that poses negative impacts on crop production in a given area. Information on weed density, distribution, and species composition may help to know weed species and predict yield losses in deciding whether it is economical to control a specific weed problem (Belachew, et al., 2015). There is no documented data on weeds species in Siltie and Gurage zones. Therefore, the activity was initiated to determine the distribution of weeds, to document major cereal crops weed species and to identify newly introduced weeds in study areas.

Materials and Methods

Description of the study areas

The assessment was conducted in selected districts of Siltie and Gurage zones in Southern Nations Nationalities and Peoples Region (SNNPR) during 2022 cropping season on maize and wheat fields. Sankura and Lanfuro districts from Siltie zone and Mareko and Meskan districts from Gurage zones were selected (Fig. 1).

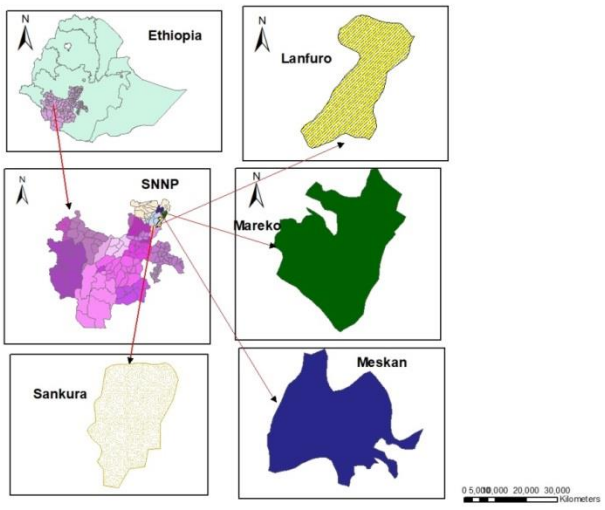

Fig. 1. Map of Ethiopia showing locations of SNNPR and surveyed areas for weed infestations.

Siltie zone is located at 172 km from Addis Ababa and situated between 1500 to 3250 m.a.s.l. The average temperature ranges from 12 to 26°C and the average annual rainfall ranges from 780 to 1818 mm. Gurage zone is situated between 1000 to 3600 m.a.s.l. The average temperature ranges from 13 to 30°C and the average annual rainfall ranges from 600 to 1600 mm. Wolkite is the capital city of Gurage zone. It is located at 192 km from Addis Ababa.

Sampling techniques

A total of 22 fields for each crop were randomly assessed within minimum of 3 kilometres distance. The selected field was assessed by using 0.5 m × 0.5 m quadrants and the growth stage of crops at the time of survey was recorded. The assessment in farms was performed with a simple random sampling technique by throwing quadrants. There were three random sampling sites per field taken. After completing the weed collection from the crop fields, the specimens were sorted, identified and classified to their family by using different weed identification guide books and manuals. Survey record sheets were prepared. The sheets were contained scientific names, common names, state of appearance, and infestation level. GPS data, Crop growth stage, cropping history, farmers' weed pest management practices, and weed population (density and frequency) were surveyed.

Data analysis

Data on density, relative density, frequency, relative frequency and summed dominant ratio were calculated by the following formula.

Frequency=(Number of quadrates in which a given species occur/total number of quadrates used)

Density (D)=Total number of individuals of a species in all quadrates/Total number of quadrates used

Relative density (RD)=(Density of a given species/Total density for all species) × 100

Relative frequency (RF)=(Frequency of a given species/Total frequency for all species) × 100

Summed Dominant Ratio (SDR)=(Relative density/Relative frequency) × 100

Results and Discussion

Weed flora composition in maize crop

A total of thirteen weed families were identified from maize field. The family Poaceae, Asteraceae and Solanaceae were dominant families with species number of (10, 6 and 3) and percent flora of (34.48, 20.69 and 10.34%), respectively (Table 1)**.** Asteraceae, Poaceae and Fabaceae were reported economically important and common in different parts of the country (Roger, et al., 2015).

Table 1. Number and proportion of weed species within thirteen diverse families in maize field.

Families	**Number of Species**	**Percept Flora**
Poaceae	10	34.48
Asteraceae	6	20.69
Solanaceae	3	10.34
Amaranthaceae	1	3.45
Papavaraceae	1	3.45
Commelinaceae	1	3.45
Convolvulaceae	1	3.45
Cyperaceae	1	3.45
Lamiaceae	1	3.45
Fabaceae	1	3.45
Portulaceae	1	3.45
Brassicaceae	1	3.45
Zygophylaceae	1	3.45

Frequency and density of weed species in maize crop

Twenty nine weed species were recorded and identified from the surveyed 22 maize fields of selected districts of the Sankura, Lanfuro, Mareko and Meskan (Table 2). The frequency of occurrence of individual weed species ranged from 0.05 up to 0.95% while, the infestation level (dominance) ranged from 0.09% up to 38.55%. The most frequent and dominant weed was Galinsoga parviflora followed by Phalaris minor (Table 2).

Dominant weeds were those species which occurred in relatively greater number than the other species. Weeds that emerge later than the crop are much less competitive in terms of crop yield loss but still may be considered problematic if they influence crop harvest ability or reduce crop quality. Weed density is an important factor in the control of weed species as explained by Wicks, et al., (1998).

Table 2. Frequency, relative frequency, density, relative density, summed dominant ratio in maize field in cropping season of 2022.

S.No.	Weed species	Family	Maize				
			D	F	RD	RF	SDR
1	*Acrachne racemosa*	Poaceae	0.27	0.18	0.38	0.02	17.38
2	*Amaranthus sp.*	Amaranthaceae	1.32	0.5	1.83	0.06	30.55
3	*Argemone mexicana* L.	Papavaraceae	0.27	0.14	0.38	0.02	23.17
4	*Avena fatua*	Poaceae	0.41	0.14	0.57	0.02	34.76
5	*Bidens pilosa* L	Asteraceae	0.5	0.14	0.69	0.02	42.49
6	*Brachiaria reptans*	Poaceae	3.09	0.23	4.28	0.03	157.58
7	*Commelina* sp.	Commelinaceae	0.82	0.23	1.13	0.03	34.760
8	*Convolvulus arvensis* L.	Convolvulaceae	0.77	0.41	1.07	0.05	21.89
9	*Cynodon dactylon* L.	Poaceae	0.59	0.27	0.82	0.03	30.13
10	*Cynodon nlemfuensis*	Poaceae	1.23	0.32	1.70	0.04	44.69
11	*Cyperus sp.*	Cyperaceae	2.45	0.55	3.40	0.07	52.14
12	*Datura metel* L.	Solanaceae	0.55	0.23	0.76	0.03	27.81
13	*Echinochloa colona*	Poaceae	0.09	0.05	0.13	0.01	23.17
14	*Eragrostis cilianensis*	Poaceae	0.5	0.14	0.69	0.02	42.49
15	*Galinsoga parviflora*	Asteraceae	38.55	0.95	53.40	0.11	467.89
16	*Guzotia scabra.*	Asteraceae	5.27	0.77	7.30	0.09	79.06
17	*Launaea cornuta*	Asteraceae	0.09	0.04	0.13	0.01	23.17
18	*Leucas martinicensis*	Lamiaceae	2.32	0.14	3.21	0.02	196.98
19	*Lolium temulentum* L.	Poaceae	0.23	0.09	0.31	0.01	28.97
20	*Medicago truncatula*	Fabaceae	1.04	0.23	1.45	0.03	53.30
21	*Nicandra*	Solanaceae	3	0.68	4.16	0.08	50.98
22	*Parthenium hysterophorus*	Astereceae	1.32	0.32	1.83	0.04	48.00
23	*Phalaris minor*	Poaceae	5.32	0.68	7.37	0.08	90.38
24	*Portulaca oleracea*	Portulaceae	0.18	0.14	0.25	0.02	15.45
25	*Setaria pumila*	Poaceae	0.5	0.18	0.69	0.02	31.86
26	*Sisymbrium irio* L.	Brassicaceae	0.55	0.18	0.76	0.02	34.76
27	*Solanum nigrum*	Solanaceae	0.14	0.14	0.19	0.02	11.59
28	*Tribulus terrestris*	Zygophylaceae	0.09	0.05	0.13	0.01	23.17
29	*Xanthium strumarium* L	Asteraceae	0.73	0.23	1.01	0.03	30.90

D-Density, F-Frequency, RD-Relative Density, RF-Relative Frequency, SDR-Summed Dominant Ratio.

Weed flora composition in wheat crop

A total of fifteen weed families were identified from wheat field. The most important families according to the number of represented species 11, 5 and 2 were Poaceae, Asteraceae and Solanaceae, respectively (Table 3). Avena fatua and Phalaris minor were the most dominant weeds in family Poaceae.

Table 3. Number and proportion of weed species within fifteen diverse families in wheat field.

Families	Number of Species	Percept Flora
Poaceae	11	36.67
Asteraceae	5	16.67
Solanaceae	2	6.67
Amaranthaceae	1	3.33
Papavaraceae	1	3.33
Commelinaceae	1	3.33
Convolvulaceae	1	3.33
Cyperaceae	1	3.33
Lamiaceae	1	3.33
Fabaceae	1	3.33
Portulaceae	1	3.33
Brassicaceae	1	3.33
Zygophylaceae	1	3.33
Rubiaceae	1	3.33
Spergulaceae	1	3.33

Frequency and density of weed species in wheat crop

Thirty weed species were recorded and identified from the surveyed 22 wheat fields of selected districts of the Sankura, Lanfuro, Mareko and Meskan (Table 4). The frequency of occurrence of individual weed species ranged from 0.05 up to 0.95% while, the infestation level (dominance) ranged from 0.05% up to 57.81%. The most frequent and dominant weed species was Galinsoga parviflora while the least dominant weed species were *Convolvulus arvensis L.* and *Leucas martinicensis* (Table 4).

Most of common weeds identified in this survey were found in annual nature. This can be explained by the fact that seeds of annual weeds survive in unfavorable conditions and they have able to complete their life cycle from seed to seed in one season.

Table 4. Frequency, relative frequency, density, relative density, summed dominant ratio in wheat field in cropping season of 2022.

S.No.	Weed Species	Family	Wheat				
			D	F	RD	RF	SDR
1	*Acrachne racemosa*	Poaceae	0.45	0.27	0.39	3.03	12.90
2	*Amaranthus*	Amaranthaceae	2.14	0.45	1.84	5.05	36.38
3	*Argemone mexicana* L.	Papavaraceae	0.18	0.09	0.16	1.01	15.48
4	*Avena fatua*	Poaceae	10.27	0.77	8.84	8.59	102.90
5	*Bidens pilosa* L	Asteraceae	1.09	0.27	0.94	3.03	30.96
6	*Brachiaria reptans*	Poaceae	3.72	0.23	3.21	2.53	126.94
7	*Commelina spp.*	Commelinaceae	0.31	0.18	0.27	2.02	13.55
8	*Convolvulus arvensis* L.	Convolvulaceae	0.05	0.05	0.04	0.51	7.74
9	*Cynodon dactylon*	Poaceae	0.36	0.14	0.315	1.52	20.64
10	*Cynodon nlemfuensis*	Poaceae	0.95	0.32	0.82	3.54	23.22
11	*Cyperus sp.*	Cyperaceae	3.90	0.55	3.36	6.06	55.47
12	*Datura metel* L.	Solanaceae	0.64	0.14	0.559	1.51	36.12
13	*Echinochloa colona*	Poaceae	0.09	0.05	0.08	0.51	15.48

14	*Eragrostis cilianensis*	Poaceae	1.81	0.36	1.56	4.04	38.70
15	*Galinsoga parviflora*	Asteraceae	57.81	0.95	49.73	10.60	468.85
16	*Galium aparine*	Rubiaceae	0.591	0.05	0.51	0.51	100.63
17	*Guzotia scabra*	Asteraceae	6.72	0.72	5.79	8.08	71.60
18	*Hyparrhenia rufa*	Poaceae	0.23	0.09	0.20	1.01	19.35
19	*Leucas martinicensis*	Lamiaceae	0.05	0.05	0.04	0.51	7.74
20	*Lolium temulentum* L.	Poaceae	1.68	0.5	1.45	5.56	26.04
21	*Medicago truncatula*	Fabaceae	2.45	0.27	2.11	3.03	69.66
22	*Nicandra*	Solanaceae	2.20	0.54	1.88	6.06	30.96
23	*Parthenium hysterophorus*	Astereceae	1.05	0.27	0.90	3.03	29.67
24	*Phalaris minor*	Poaceae	4.45	0.68	3.83	7.56	50.57
25	*Portulaca oleracea*	Portulaceae	0.14	0.09	0.12	1.01	11.61
26	*Setaria pumila*	Poaceae	1.05	0.31	0.90	3.54	25.43
27	*Sisymbrium irio* L.	Brassicaceae	0.5	0.18	0.43	2.02	21.29
28	*Spergula arvensis* L.	Spergulaceae	0.23	0.05	0.20	0.51	38.70
29	*Tribulus terrestris*	Zygophylaceae	0.27	0.14	0.24	1.52	15.48
30	*Xanthium strumarium* L.	Asteraceae	0.60	0.22	0.51	2.53	20.13

D-Density, F-Frequency, RD-Relative Density, RF-Relative Frequency, SDR-Summed Dominant Ratio.

Conclusion

Assessment of weeds were done in Sankura, Lanfuro, Mareko and Meskan districts in the maize and wheat farms during 2022 cropping season. The most frequent and dominant weed was Galinsoga parviflora in maize and wheat fields. The density of Galinsoga parviflora was 38.55 and 57.81% in maize and wheat fields, respectively. From grass family (Poaceae) Avena fatua and Phalaris minor were dominant weeds in surveyed areas. The survey result showed that the dominant weeds were problematic in study areas. Therefore, it is necessary to introduce different weed management practices to study areas.

Funding

This research was funded by Southern Agricultural Research Institution.

Conflict of Interest

The authors declare no conflict of interest.

References

Abouziena, H.F., El-Karmany, M.F., Singh, M., Sharma, S.D. (2007). Effect of nitrogen rates and weed control treatments on maize yield and associated weeds in sandy soils. Weed Technology, 21:1049-1053.

Ali, R., Khalil, S.K., Raza, S.M. (2003). Effect of herbicides and row-spacing on maize (*Zea mays* L.). Pakistan Journal of Weed Science Research (Pakistan).

Belachew, K., Tessema, T. (2015). Assessment of weed flora composition in Parthenium (*P. hysterophorus* L.) infested area of East Shewa Zone, Ethiopia. Malaysian Journal of Medical and Biological Research, 2:105-112.

Central Statistical Agency (CSA). (2015). Report on area and production of major crops (private peasant holdings, meher season). Agricultural Sample Survey 2014/15.

Central Statistical Authority of Ethiopia (CSA). (2017). Report on area and production of major crops, private peasant holdings, meher season, Addis Ababa.

Dalley, C.D., Bernards, M.L., Kells, J.J. (2006). Effect of weed removal timing and row spacing on soil moisture in corn (*Zea mays*). Weed Technology, 20:399-409.

Dalga, D., Sharmaa, J.J., Tana, T. (2014). Evaluation of herbicides and their combinations for weed management in bread wheat (*T. aestivum* L.) in southern Ethiopia. International Journal of Novel Research in Life Science, 1:31-47.

FAO. (2015). Agricultural Production Statistics. FAOSTAT. Rome.

Food and Agriculture Organization Statistics (FAOSTAT). (2013). Food and agriculture organization statistics data base, agricultural production indices. Roma, Italy.

Khan, S.A., Hussain, N., Khan, I.A., Khan, M., Iqbal, M. (1998). Study on weeds control in maize. Sarhad Journal of Agriculture (Pakistan).

Rana, S.S., Rana, M.C. (2016). Principles and practices of weed management. Department of Agronomy, College of Agriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, p:138.

Rao, V.S. (2000). Principles of weed science. Crc Press.

Nkoa, R., Owen, M.D., Swanton, C.J. (2015). Weed abundance, distribution, diversity, and community analyses. Weed Science, 63:64-90.

Tena, E., Dejene, M. (2012). Quantitative and qualitative determination of weeds in cotton-growing areas of humera and metema, northwestern Ethiopia. Ethiopian Journal of Applied Science and Technology, 3:57-69.

Amare, T., Sharma, J.J., Zewdie, K. (2014). Effect of weed control methods on weeds and wheat (*T. aestivum* L.) yield. World Journal of Agricultural Research, 2:124-128.

Debelle, T., Bogale, T., Negassa, W., Workayehu, T., Liben, M., Mesfin, T., Mazengia, W. (2002). A review of fertilizer management research on maize in Ethiopia.

Walter, A.M., Christensen, S., Simmelsgaard, S.E. (2002). Spatial correlation between weed species densities and soil properties. Weed Research, 42:26-38.

Wicks, G.A., Popken, D.H., Mahnken, G.W., Hanson, G.E., Lyon, D.J. (2003). Survey of winter wheat (*T. aestivum*) stubble fields sprayed with herbicides in 1998: weed control. Weed Technology, 17:475-484.

Citation:

Bamud, K., Kebede, M., Temam, B. (2023). Assessment of weed species diversity on maize and wheat crops in Siltie and Gurage zones, Central Ethiopia. *Ukrainian Journal of Ecology.* 13:1-7.